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Nanostructured Thin Film Solar Cells: A Heterojunction of PbS Colloidal Quantum Dots and TiO2 Nanopillars HO-CHEOL KIM, IBM Almaden Research Center, ILLAN KRAMER, University of Toronto, JOHN BASS, TEYA TOPURIA, LESLIE KRUPP, PHILIP RICE, IBM Almaden Research Center, RATAN DEBNATH, LUKASZ BRZOZOWSKI, LARISSA LEVINA, EDWARD SARGENT, University of Toronto — Colloidal quantum dot (CQD) has been recognized as a promising solar cell material that offers tunable band gap and inexpensive solution process. Recent report demonstrated the power conversion efficiency (PCE) of above 5% (AM 1.5) using thin films of PbS CQDs and TiO_2 nanoparticles. This so-called depleted-heterojunction-CQD solar cells have overcome limitations of CQD Schottky devices and promised potential for further improvement of solar cell performance. In this paper, we report the effect of nanostructures of TiO_2 on the performance of heterojunction CQD solar cells. Well-defined nanopillars of TiO_2 were prepared on top of F:SnO_2 substrate using micro-transfer molding technique. TiO_2 nanopillars of 70 nm in diameter (half-width), 340 nm in height and 275 nm in center-to-center distance were used for subsequent layer-by-layer spin coating of PbS CQD. PCE of >5% was measured for the nanopillar solar cells without extensive optimization. Detailed studies on the microstructure of materials, surface properties, optical and electrical properties and optimization will be discussed along with performance of flat TiO_2-PbS CQD solar cells.

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